THE FOLLOWING ARE THE ENGLISH TRANSLATION OF ANNEXES TO THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT (ARTICLE 34):

Amended Sheets (Pages 1, 5, 5/1, 6, 7, 7/1, 20, 21, 22, 22/1, 23, 24, 25, 25/1)

WHAT IS CLAIMED IS:

1. A method for suppressing charging of a component in a vacuum processing chamber of a plasma processor, the plasma processor, comprising:

a vacuum processing chamber in which plasma is generated to plasma-process an object to be processed;

a block made of a conductive material and having a flow path of a heat medium in an inner part thereof; and

a component in the vacuum processing chamber disposed to be in contact with the block and made at least partly of an insulative material, and

said plasma processor controlling temperature of the component in the vacuum processing chamber by circulating an insulating fluid as the heat medium in the flow path,

wherein, when the insulating fluid is circulated in the flow path while the object to be processed is not in the vacuum processing chamber and no plasma is generated, pressure inside the vacuum processing chamber is controlled to a predetermined pressure while inert gas is supplied into the vacuum processing chamber, thereby suppressing increase in charged voltage of the component in the vacuum processing chamber.

2. The method for suppressing charging of the component in the vacuum processing chamber of the plasma processor as set forth in claim 1,

wherein the insulating fluid is a fluorinated refrigerant.

3. The method for suppressing charging of the component in the vacuum processing chamber of the plasma processor as set forth

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in claim 1,

wherein volume resistivity of the insulative material is 10^9 Ω-cm or higher.

4. The method for suppressing charging of the component in the vacuum processing chamber of the plasma processor as set forth in claim 3,

wherein the insulative material is ceramic.

5. The method for suppressing charging of the component in the vacuum processing chamber of the plasma processor as set forth in claim 4,

wherein the component in the vacuum processing chamber is an electrostatic chuck and the block is a lower electrode made of aluminum.

6. The method for suppressing charging of the component in the vacuum processing chamber of the plasma processor as set forth in claim 5,

wherein the vacuum processing chamber has an upper electrode disposed in parallel with the lower electrode at a position a predeteremined distance away from the lower electrode, and the predetermined pressure is not lower than 0.6 times nor higher than 2.0 times a pressure that is calculated based on a minimum sparking condition of a Paschen's curve determined for each kind of the inert gas when a discharge distance is defined as the predetermined distance.

7. The method for suppressing charging of the component in the vacuum processing chamber of the plasma processor as set forth in claim 1,

wherein the inert gas is nitrogen gas.

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8. The method for suppressing charging of the component in the vacuum processing chamber of the plasma processor as set forth in claim 7,

wherein the predetermined pressure is not lower than about 13 Pa nor higher than about 40 Pa.

9. The method for suppressing charging of the component in the vacuum processing chamber of the plasma processor as set forth in claim 1,

wherein the predetermined pressure is intermittently controlled.

10. The method for suppressing charging of the component in the vacuum processing chamber of the plasma processor as set forth in claim 9,

wherein the intermittent pressure control is performed while a flow rate of the inert gas is varied.

11. The method for suppressing charging of the component in the vacuum processing chamber of the plasma processor as set forth in claim 9,

wherein the intermittent pressure control is performed by a pressure control device while a flow rate of the inert gas is fixed.

12. A plasma processor, comprising:

a vacuum processing chamber in which plasma is generated to plasma-process an object to be processed;

a block made of a conductive material and having a flow path of a heat medium in an inner part thereof; and

a component in the vacuum processing chamber disposed to be in contact with said block and made at least partly of an insulative material, and

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said plasma processor controlling temperature of said component in the vacuum processing chamber by circulating an insulating fluid as the heat medium in the flow path,

wherein, when the insulating fluid is circulated in the flow path while the object to be processed is not in said vacuum processing chamber and no plasma is generated, pressure in said vacuum processing chamber is controlled to a predetermined pressure while inert gas is supplied into said vacuum processing chamber, thereby suppressing increase in charged voltage of said component in the vacuum processing chamber.

13. The plasma processor as set forth in claim 12, wherein the insulating fluid is a fluorinated refrigerant.

14. The plasma processor as set forth in claim 12, wherein volume resistively of the insulative material is 10^9 Ω-cm or higher.

15. The plasma processor as set forth in claim 14, wherein the insulative material is ceramic.

16. The plasma processor as set forth in claim 15, wherein said component in the vacuum processing chamber is an electrostatic chuck and said block is a lower electrode made of aluminum.

17. The plasma processor as set forth in claim 16, wherein said vacuum processing chamber has an upper electrode disposed in parallel with the lower electrode at a position a predeteremined distance away from the lower electrode, and the predetermined pressure is not lower than 0.6 times nor higher than 2.0 times a pressure that is calculated based on a minimum sparking condition of a Paschen's curve determined for each kind of the inert

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gas when a discharge distance is defined as the predetermined distance.

18. The plasma processor as set forth in claim 12, wherein the inert gas is nitrogen gas.

19. The plasma processor as set forth in claim 18, wherein the predetermined pressure is not lower than about 13 Pa nor higher than about 40 Pa.

20. The plasma processor as set forth in claim 12, wherein the predetermined pressure is intermittently controlled.

21. The plasma processor as set forth in claim 20, wherein the intermittent pressure control is performed while a flow rate of the inert gas is varied.

22. The plasma processor as set forth in claim 20, wherein the intermittent pressure control is performed by a pressure controlling device while the flow rate of the inert gas is fixed.

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[0073] A method for suppressing charging of a component in a vacuum processing chamber of a plasma processor and a plasma processor according to the present invention are usable in the semiconductor manufacturing industry which manufactures semiconductor devices, and in other fields.

[0074] Therefore it has industrial applicability.

pressure is not lower than 0.6 times nor higher than 2.0 times a pressure that is calculated based on a minimum sparking condition of a Paschen's curve determined for each kind of the inert gas when a discharge distance is defined as the predetermined distance.

[0023] The present invention is also characterized in that the inert gas is nitrogen gas and is also characterized in that the predetermined pressure is not lower than about 13 Pa nor higher than about 40 Pa.

[0024] The present invention is also characterized in that the predetermined pressure is intermittently controlled, and is also characterized in that the intermittent pressure control is performed while a flow rate of the inert gas is varied, or the intermittent pressure control is performed by a pressure controlling device while a flow rate of the inert gas is fixed.

Brief Description of Drawings

[0025] FIG. 1 is a view showing a schematic configuration of a plasma processor according to an embodiment of the present invention.

[0026] FIG. 2 is a chart showing operation timings of major portions in the plasma processor in FIG. 1.

[0027] FIG. 3 is a chart showing time-dependent change of charged voltage in the embodiment as compared with that in a conventional example.

[0028] FIG. 4 is a chart showing a Paschen's curve.

[0029] FIG. 5 is a chart showing time-dependent change of the charged voltage when pressure control is performed.

[0030] FIG. 6 is a chart showing time-dependent change of the

[0018] A plasma processor of the present invention is a plasma processor including: a vacuum processing chamber in which plasma is generated to plasma-process an object to be processed; a block made of a conductive material and having a flow path of a heat medium in an inner part thereof; and a component in the vacuum processing chamber disposed to be in contact with the block and made at least partly of an insulative material, and the plasma processor controlling temperature of the component in the vacuum processing chamber by circulating an insulating fluid as the heat medium in the flow path, wherein, when the insulating fluid is circulated in the flow path while the object to be processed is not in the vacuum processing chamber and no plasma is generated, pressure in the vacuum processing chamber is controlled to a predetermined pressure while inert gas is supplied into the vacuum processing chamber, thereby suppressing increase in charged voltage of the component in the vacuum processing chamber.

[0019] The present invention is also characterized in that the insulating fluid is a fluorinated refrigerant.

[0020] The present invention is also characterized in that volume resistivity of the insulative material is 10^9 Ω-cm or higher, and is also characterized in that the insulative material is ceramic.

[0021] The present invention is also characterized in that the component in the vacuum processing chamber is an electrostatic chuck and the block is a lower electrode made of aluminum.

[0022] The present invention is also characterized in that the vacuum processing chamber has an upper electrode disposed in parallel with the lower electrode at a position a predeteremined distance away from the lower electrode, and the predetermined

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described above.

Disclosure of the Invention

[0016] Therefore, it is an object of the present invention to provide a method for suppressing charging of a component in a vacuum processing chamber of a plasma processor and a plasma processor which are capable of preventing the component in the vacuum processing chamber of the plasma processor from being charged to high voltage and protecting an insulative material against breakdown caused by electric discharge or the like.

[0017] According to the present invention, provided is a method for suppressing charging of a component in a vacuum processing chamber of a plasma processor, the plasma processor including: a vacuum processing chamber in which plasma is generated to plasma-process an object to be processed; a block made of a conductive material and having a flow path of a heat medium in an inner part thereof; and a component in the vacuum processing chamber disposed to be in contact with the block and made at least partly of an insulative material, and the plasma processor controlling temperature of the component in the vacuum processing chamber by circulating an insulating fluid as the heat medium in the flow path, wherein, when the insulating fluid is circulated in the flow path while the object to be processed is not in the vacuum processing chamber and no plasma is generated, pressure inside the vacuum processing chamber is controlled to a predetermined pressure while inert gas is supplied into the vacuum processing chamber, thereby suppressing increase in charged voltage of the component in the vacuum processing chamber.

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METHOD FOR SUPPRESSING CHARGING OF COMPONENT IN VACUUM PROCESSING CHAMBER OF PLASMA PROCESSOR AND PLASMA PROCESSOR

Technical Field

[0001] The present invention relates to a plasma processor that generates plasma to perform etching or the like of a semiconductor wafer or the like and to a method for suppressing charging of a component in a vacuum processing chamber of the plasma processor.

Background Art

[0002] Conventionally, plasma processors that generate plasma to apply predetermined processing to an object to be processed by the action of the plasma have been often used.

[0003] For example, in a semiconductor device manufacturing field, etching and film deposition are conducted by the action of plasma on a substrate to be processed such as a semiconductor wafer or the like when a microscopic circuit structure of a semiconductor device is to be formed.

[0004] In such a plasma processor, since plasma is generated in a vacuum processing chamber, the temperature may possibly rise due to the action of the plasma. Therefore, many plasma processors are provided with a temperature control mechanism for controlling the temperature of a predetermined portion.

[0005] For example, in a plasma processor of a so-called parallel plate type that applies high frequency power between an upper electrode and a lower electrode facing each other to generate plasma, a mounting table (susceptor) for placing a substrate to be processed such as a semiconductor wafer thereon also functions as the lower

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